REMARKS

Claims 1-23 are pending. Claims 1-18 have been amended. Claims 19-23 have been added. Support for the claim amendments is described below. Support for the new claims can be found in the specification, *inter alia*, at page 3, lines 3-5, page 5, lines 21-24, page 9, lines 9-28, page 12, lines 13-21, and Fig. 15. Accordingly, applicant respectfully submits that this amendment does not add new matter.

Applicant requests reconsideration in light of the following remarks

Amendments directed to correcting obvious errors

An obvious error has been discovered in a number of places in the claims and specification. In several locations, the symbol "=" should be "$\geq$" (greater than or equal to). For example, the mathematical symbols "=" in line 4 of the original abstract should have been "$\geq$" (greater than or equal to), otherwise the original statement "...an IR wavelength λ_{IR}, where 760 nm = λ_{IR} = 920 nm" makes no sense. The intent of Applicant was to describe that λ_{IR} can have a wavelength between (and including) 760 nm to 920 nm. Other locations of mathematical symbol obvious errors include: (1) page 5, line 18, where "=" has been replaced by "$\geq$"; (2) claim 1, line 3, where "=" has been replaced by "$\geq$"; and (3) claim 1, line 7, where "=" has been replaced by "$\geq$". This obvious error would have been recognized by a person of ordinary skill in the art, and the correct symbols that should have been used would also have been recognized. Thus, the above changes do not constitute new matter. Cf. MPEP 2163.07, sec. II.

The original specification and claims clearly evidence that the mathematical symbol mistake was an obvious error recognizable to one of ordinary skill in the art. For example, original claim 17, which depends from claim 1, recites "the IR focus lies between 760 nm and 920 nm" and original claim 18, which depends from claim 1, previously recited "the DUV focus lies between 200 nm and 300 nm." In addition, original claims 9-16, which depend directly or indirectly from claim 1 recite specific examples of wavelengths within the intended ranges: λ_{DUV} = 248 nm $\pm$ 8 nm (claims 9-13), λ_{DUV} = 266 nm $\pm$ 8 nm (claims 9, 14-16), λ_{IR} = 760 nm (claim 10), λ_{IR} = 825 nm (claim 11), λ_{IR} = 885 nm (claim

12), λ_{IR} = 905 nm (claim 13), λ_{IR} = 780 nm (claim 14), λ_{IR} = 785 nm (claim 15), and λ_{IR} = 845 nm (claim 16). Further, Tables 1-4 and 6-8 show examples where λ_{IR} can be 760 nm, 825 nm, 885 nm, 905 nm, 780 nm, 785 nm, and 845 nm, respectively. In addition, these same tables provide examples for λ_{DUV} at 248 nm and 266 nm. Moreover, the spectral curves in Figs. 9-13 and 23-25 show that the values for λ_{DUV} and λ_{IR} can be at wavelengths $\lambda_{DUV} \geq 235$ nm and $\lambda_{IR} \geq 760$ nm.

Applicant requests reconsideration in light of these remarks.

<u>Objections to the Specification and Claims</u>

On page 2 of the Office Action dated May 9, 2001, the abstract was objected to as not making sense. Applicant has amended the abstract as discussed above. Reconsideration of this objection is respectfully requested.

Applicant has also amended the specification at page 3, third full paragraph to change "formulas" to "starting parameters" and page 4, first paragraph, for readability purposes.

Applicant has also amended the specification to remove specific references to the claims in the Field of the Invention and Summary of the Invention sections.

Applicant also submits that the objections to claim 17 has been made moot in light of the amendments above. Claim 18 has been amended to recite that the focal length is "1.6 mm or less". See specification, page 5, lines 21-24.

<u>Claim rejections under 35 USC § 112, first paragraph:</u>

Claims 1-18 are rejected under 35 USC § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art ... to make and/or use the invention. Applicant respectfully requests reconsideration of the enablement rejection based on the following.

Applicant respectfully submits that the specification sufficiently teaches one skilled in the art how to make and use the claimed microscope objective without undue experimentation. First, the claims and specification have been amended to correct for

obvious errors. Thus, the lack of clarity due to the aforementioned obvious errors may remove the Patent Office's questions concerning the adequacy of the specification.

Second, the specification is enabling as it provides at least seven different example microscope objectives which provide the same focus for both DUV and IR light. See e.g., Figs. 1-4 and 17-19. These examples are not limiting with respect to the claim scope, but rather provide example designs in accordance with the claimed invention. See e.g., page 9, lines 6-28. These examples are described in detail in the specification from page 9, line 30 through page 14, line 29. In accordance with MPEP 2164.01(b), applicant respectfully submits that the specification is enabling. See MPEP 2164.01(b), which states: "As long as the specification discloses at least one method for making and using the claimed invention that bears a reasonable correlation to the entire scope of the claim, then the enablement requirement ... is satisfied." (emphasis added, case citation omitted).

For example, Fig. 1 shows a first embodiment of a lens design. Here, the penultimate lens element is a diverging doublet lens L12a and L12b having the claimed object-side outer radius smaller than the image side outer radius. The details of how this particular specific example objective is configured is provided in Table 1 (Fig. 5), which details lens compositions, surface curvatures, and distances between lens elements, to build a 125x/0.90 objective with a focal length of 1.6 mm and a parfocal focus at λ_{DUV} = 248 nm and λ_{IR} at 760 nm. The corresponding spectral image locus curves for this lens are provided in Fig. 9, which shows the focus for the paraxial region (dotted line) and for the full aperture (solid line). Fig. 9 further shows a minimum at a DUV wavelength λ_{DUV} that defines a zero line (at or about 248 nm $\pm$ 8 nm), as well as a zero transition at an IR wavelength λ_{IR} (at or about 760 nm). Compare this example to the example of Figs. 4, 8, and 12, especially Fig. 12, which shows the zero transition at an IR wavelength λ_{IR}, at or about 905 nm. A DUV wavelength band within which the objective is in focus is defined in each case around the minimum within the depth of field (λ_{DUV} $\pm$ 8 nm). The zero transition designates a focus at the IR wavelength λ_{IR} that is parfocal with the DUV focus. See e.g. specification, page 10, lines 6-13. Thus, Applicant respectfully submits that based on at least Figs. 1, 5, and 9, one skilled in the art could make and use an objective lens that falls within the claim scope without undue experimentation. Similarly, the other six

example configurations provide additional teachings to those skilled in the art to make and/or use the claimed invention without undue experimentation. See e.g., Figs. 2-4, 6-8, 10-13, and 17-25.

Third, the specification addresses the Patent Office's concerns over the compensation of dispersion. On page 3, lines 16 – 31, the specification describes the appropriate starting parameters for calculating the claimed objective lens. An important criteria used for evaluating the focusing properties are the so-called spectral image locus curves of an objective, which involve a comparison between the image locus curves for the paraxial region and the image locus curves for full aperture (see page 3, lines 16-19). Good agreement between these two image locus curves indicates good correction of spherical aberration (see e.g. page 3, lines 30-31). A good agreement between these two curves is not an inherent property of the lens groups or the used materials, but can be determined based on the multiple examples provided in the specification. Therefore, the specification describes how a good agreement of the image locus curves can be achieved: by a special shaping of the penultimate lens element, e.g. lens element L12, of the objective. As is claimed, the object-side outer radius is smaller than the image-side outer radius. (see page 3, lines 23-28).

Therefore a person skilled in the art of optical system design could find all necessary information in the original specification to set the starting parameters in, e.g., a software program for calculating of optical systems. Applicant respectfully submits that this type of effort is not undue because typical software programs on the market are known, such as Code V (by Optical Research Assoc.), Winlens (by Linos Corp.), and ZEMAX, to name a few. These programs allow a person skilled in the art to start the program with various starting parameters. To obtain a desired optical design, a person skilled in the art can use the starting parameters and then calculate an optical system, e.g. in a step-by-step manner to achieve the desired quality of optics.

<u>Claim rejections under 35 U.S.C. § 112, second paragraph:</u>

Claims 1-18 were rejected under 35 USC 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter. For the reasons

stated herein, Applicant respectfully submits that the amended claims render moot the rejections under 112, second paragraph.

Regarding claim 1, the phrase "has a focus at a DUV wavelength λ_{DUV} =235 nm" has been amended to correct an obvious error. Claim 1 now recites "$\lambda_{DUV} \geq 235$ nm," which makes physical sense in light of the λ_{DUV} wavelengths discussed above. Claim 1 also now recites $\lambda_{IR} \geq 760$ nm for the reasons stated above. The phrase "short focal length" has been removed. The phrase "for which purpose" has been removed. Claim 1 has also been amended so that it is clear that the "penultimate lens element" is the penultimate (next to last) lens element of the lens group that comprises the objective. The term "much smaller" has been changed to "smaller." Applicant requests reconsideration in light of the comments above.

Claims 3-6 were amended to recite that the penultimate lens element is diverging, to provide proper antecedent basis and not to narrow the scope of that claim term. Applicant requests reconsideration in light of the comments above.

Claim 7 was amended to provide a more clear structural relationship between the lens elements recited therein. As viewed in an imaging direction, the penultimate lens element is disposed between the converging lens group and the diverging doublet. The term "much smaller" has been removed. Applicant requests reconsideration in light of the comments above.

Claim 8 has been amended to properly identify which converging lens and doublet are being referred to. Claim 8 now recites that the converging individual <u>second</u> lens and the <u>first</u> doublet are combined into a triplet <u>lens</u> having a material sequence fluorite/quartz glass/fluorite. Applicant requests reconsideration in light of the comments above.

Based on the amendment to claim 1, Applicant respectfully submits that the claims 9-17 are within the scope of the wavelength ranges recited in claim 1. See amended claim 1, which recites "$\lambda_{DUV} \geq 235$ nm" and "$\lambda_{IR} \geq 760$ nm." Thus, the "contradictions" due to the obvious errors, now corrected, have been removed. Also, references to the enumerated Tables in the specification have been removed. Claim 17 was amended to recite that the IR wavelength, λ_{IR}, includes the range 760 nm $\geq \lambda_{IR} \geq$ 920 nm. Applicant requests reconsideration in light of the comments above.

Claims 1-17 have also been amended for to place the pending claims in better idiomatic English, as well as to provide proper antecedent basis where appropriate.

Claim 18 has been amended to recite that the focal length of the objective is "1.6 mm or less." See specification, page 5, lines 21-24, for support.

Claim rejections under 35 USC § 103(a):

Claims 1, 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over the patent issued to Hayashi (U.S. Patent No. 5,144,475). Claims 2, 3 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over the patent issued to Hayashi as applied to claim 1 above, and further in view of the patent issued to Ono et al. (U.S. Patent No. 5,142,410). Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over the patent issued to Hayashi and Ono et al as applied to claim 2 above, and further in view of the patent issued to Shafer et al. (U.S. Patent No. 5,717,518). Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over the patent issued to Hayashi as applied to claim 1 above, and further in view of the patents issued to Ono et al and Shafer. Applicant respectfully requests reconsideration for the following reasons.

As no references were applied to claims 7-16, applicant assumes that the features of those claims are patentable over the art of record.

Hayashi fails to teach or suggest each element of the invention as claimed in claim 1 or its dependent claims. First, applicant agrees with the Patent Office (see Office Action, page 6) that Hayashi fails to teach or suggest a microscope objective with an IR wavelength λ_{IR} <u>at the same focal point</u> as the DUV focus at λ_{DUV}. Hayashi fails to mention such a feature. As discussed above, the specification is enabling and provides seven working examples that provide a same focus at a DUV and an IR wavelength. As such, a prima facie case of obviousness has not been established.

Further, regarding inherency, the "fact that a certain result <u>may</u> occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic." MPEP 2112 (citations omitted). In *In re Rijckaert*, 3 F.3d 1531, 1534, 28 USPQ 1955 (Fed. Cir. 1993), the Federal Circuit reversed the Board's rejection under obviousness based on an alleged inherent feature in the cited reference. The Federal Circuit stated: "That which may

be inherent is not necessarily known. Obviousness cannot be predicated on what is unknown. Such a retrospective view of inherency is not a substitute for some teaching or suggestion supporting an obviousness rejection." *Rijckaert*, 3 F.3d at 1534. (citations omitted). As such, the Patent Office has not established obviousness based on any inherency of the claimed features in the Hayashi reference.

Second, and related, the claimed invention of claim 1 is patentable over Hayashi due to secondary considerations, primarily unexpected results. The Patent Office admits that conventional expectations would lead one of skill in the art to believe that an objective cannot focus UV and IR light to the same focus. See Office Action, page 3 ("It is therefore expected that the focal point for the light of these very different wavelengths would be different").

The specification directly addresses this unexpected result. On page 4 of the specification, second and third paragraphs, it is stated:

> As a result of the size relationship according to the present invention among the outside radii, the imaging beam that up to that point has been slightly deflected by the preceding lenses or cemented groups is strongly refracted. This kind of beam deflection violates the rule ordinarily applied in optical computation that the beam must always be modified smoothly at each imaging element. For example, a sharp transition in the beam makes the objective highly sensitive to tolerances, so that an objective of this kind is difficult to produce or makes stringent demands in terms of production.
>
> On the other hand, however, only with a penultimate element having this particular shape did it prove possible to achieve the same focus both for a region around a DUV wavelength λ_{DUV} and for an IR wavelength λ_{IR}. If the relevant penultimate element is equipped, in an objective according to the present invention, with a moderate shape so that the previously deflected beam profile is smoothed again, then both the good correction and the focus for the IR wavelength λ_{IR} are lost.

Further, as discussed above, the specification teaches at least <u>seven</u> different objective configurations where the unexpected is the result. As Hayashi fails to teach or suggest a microscope objective that focuses DUV and IR light at the same focus, or even mention the possibility of using IR light, Hayashi cannot render obvious the claimed invention.

Concerning the rejections based on Hayashi combined with Ono and/or Shafer, claims 2-6 are patentable for at least the reasons discussed above. In addition, Ono is directed to endoscopes and Shafer is directed to a catadioptric imaging system. Applicant respectfully submits that these references would not be looked to by one of ordinary skill in the art to address the problem described in the present application or the claimed solution for the field of microscopes. Even if, arguendo, one of ordinary skill in the art would look to combine these secondary references with Hayashi, the resulting combination would not produce the claimed invention as neither Shafer no Ono overcome the deficiencies of Hayashi.

With respect to amended claim 18, this claim is patentable over the art of record for at least the reasons stated above and additionally because Hayashi fails to teach or suggest a focal length of "1.6 mm or less," as claimed. In contrast, Hayashi teaches microscope objectives with focal lengths of 15 mm. See e.g., Hayashi, col. 6., line 65, col. 8, line 49, col. 12, line 7, and col. 13, line 32.

For at least the reasons mentioned above, claims 1-18 are patentable over the references of record.

New Claims 19-23

The combination of references fails to teach or suggest the microscope of claims 19 and 20 and the objective of claims 21-23 for at least the reasons discussed above. In addition, the combination of references fails to teach "an IR auto focus" (claim 19), the focal length of 1.6 mm or less (claims 20 and 22), the combination of lenses forming the objective in claim 21, and the same IR/DUV focal point for the objective (claim 23).

Accordingly, applicant respectfully submits that claims 19-23 are patentable over the references of record.

Conclusion

If applicant has not accounted for any fees required by this Amendment, the Commissioner is hereby authorized to charge to our Deposit Account No. 19-0741. A THREE MONTH petition for an extension of time is submitted herewith. If applicant have not accounted for a required extension of time under 37 C.F.R. § 1.136, that extension is requested and the corresponding fee should be charged to our Deposit Account.

The Examiner should feel free to contact the undersigned at (202) 672-5592, if there is anything the undersigned can do to assist the Examiner or expedite prosecution of the application.

Respectfully submitted,

Date 11/9/01

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Version with Markings to Show Changes Made (Specification)

Please replace Page 1, first full paragraph, with the following:

The invention concerns a DUV-capable microscope objective having the features [of the preamble of independent Claim 1] described herein.

Please replace Page 3, first full paragraph, with the following:

This object is achieved by a DUV objective that has the features [of Claim 1] described herein. Advantageous embodiments of the objective are [recited in the dependent claims] also described.

Please replace Page 3, 3rd full paragraph, with the following:

An objective according to the present invention comprises a system of lenses made of quartz glass and fluorite. It has a focus in a wavelength band around a DUV wavelength λ_{DUV} selected for DUV illumination, and the same focus for an IR wavelength λ_{IR} in the near IR region. It was hitherto considered impossible to compute a focus combination of this kind, since with usual computation [formulas] starting parameters and current methods and theories of optical computation an objective of this kind, focusing in both IR and DUV, was believed to be impossible to realize. The criteria used for evaluating the focusing properties are the so-called spectral image locus curves of an objective, which involve a comparison between the image locus curve for the paraxial region and the image locus curve for full aperture. The spectral image locus curves indicate the focal points of the objective as a function of wavelength.

Page 4, 1st paragraph, please revise as follows:

Good agreement between the two image locus curves indicates good correction of spherical aberration. Depending on the exemplary embodiment of the objective according to the present invention, the penultimate element is constructed either as a doublet or a triplet, or as a double in combination with an individual lens, or as individual lenses only. As materials, combinations of quartz glass and fluorite or of quartz glass and lithium fluoride can be used. Specific sequences of materials prove advantageous in this context. In one

advantageous embodiment, for example, a doublet has the material sequence quartz glass/fluorite in the imaging direction, [and] respectively a triplet has the material sequence quartz glass/fluorite/quartz glass or quartz glass/lithium fluoride/quartz glass in the imaging direction.

Page 5, 2nd full paragraph, please revise as follows:

If a specific DUV wavelength is then taken as the basis for calculating the DUV focus, with a penultimate element according to the present invention it is in fact possible to construct an objective to match each of a number of IR focus wavelengths. As a result, a respective IR autofocus-capable DUV objective can be described for IR wavelengths [=] $\geq$ 760 nm, i.e. to match a plurality of possible IR laser diodes for an IR laser autofocus system.

Version with Markings to Show Changes Made (Claims)

1. (amended) A DUV-capable microscope objective, comprising:

[that contains] a lens group[s] that comprises a plurality of lens elements having[made of] quartz glass and fluorite compositions, wherein the objective [and] has a DUV focus at a DUV wavelength, λ_{DUV} [=] $\geq$ 235 nm [as well as a short focal length], wherein [a)] the DUV focus encompasses a DUV wavelength region $\lambda_{DUV} \pm \Delta\lambda$, where $\Delta\lambda$ = 8 nm[;], wherein [b)] the objective [additionally] has an IR focus for an IR wavelength λ_{IR} [=] $\geq$ 760 nm at the same focal point as the DUV focus at λ_{DUV}[;], and wherein [c) for which purpose] a penultimate lens element of the [objective] lens group [is of] comprises a concave configuration on both sides, [and its] wherein an object-side outer radius of the penultimate element is [much] smaller than its image-side outer radius.

2. (Amended) The objective as defined in Claim 1, wherein the penultimate lens element is a doublet, concave on both sides, [that] and has [the] a material sequence of quartz glass/fluorite in [the] an imaging direction.

3. (Amended) The objective as defined in Claim 1, wherein the [diverging] penultimate lens element is a diverging triplet lens, concave on both sides, [that] and has [the] a material sequence of quartz glass/fluorite/quartz glass in [the] an imaging direction.

4. (Amended) The objective as defined in Claim 1, wherein the [diverging] penultimate lens element is a diverging triplet lens, concave on both sides, that has [the modified] a material sequence of quartz glass/lithium fluoride/quartz glass in [the] an imaging direction.

5. (Amended) The objective as defined in Claim 1, wherein the [diverging] penultimate lens element is diverging, is concave on both sides, and comprises [is made up of] individual lenses made of quartz glass and fluorite.

6. (Amended) The objective as defined in Claim 2, wherein the [diverging] penultimate lens element is diverging, is concave on both sides, and comprises [is made up of] individual lenses made of quartz glass and lithium fluoride.

7. (Amended) The objective as defined in Claim 1, wherein the objective comprises, as viewed in [the] an imaging direction[, the following schematic configuration]:

[-] a converging individual first lens [made of] comprising quartz glass as [the] a front lens element disposed closest to an object being imaged;

[-] a converging individual second lens element [made of] comprising fluorite;

[-] a first doublet comprising a diverging third lens [made of] comprising quartz glass and a converging fourth lens [made of] comprising fluorite;

[-] a first triplet combined of a fifth lens [made of] comprising fluorite, a sixth lens [made of] comprising quartz glass and a seventh lens [made] comprising fluorite;

[-] a second triplet combined of an eighth lens [made of] comprising quartz glass and a ninth lens [made of] comprising fluorite and a tenth lens [made of] comprising quartz glass;

[-] a converging lens group comprising one or more lenses;

[- a penultimate diverging element which is of concave shape on both sides and whose object-side outer radius is much smaller than the image-side outer radius;] and

[-] a diverging doublet [combined of] comprising a converging lens [made of] comprising quartz glass and a diverging lens [made of] comprising fluorite, wherein the penultimate lens element is diverging and is disposed between the converging lens group and the diverging doublet.

8. (Amended) The objective as defined in Claim 7, wherein the converging individual second lens and the first doublet are combined into a triplet lens having [the] a material sequence fluorite/quartz glass/fluorite.

9. (Amended) The objective as defined in Claim 7, wherein [it] the objective has a DUV focus in a DUV wavelength region λ_{DUV} = 248 nm ± 8 nm or in a DUV wavelength region λ_{DUV} = 266 nm ± 8 nm.

10. (Amended) The objective as defined in Claim 7, wherein [it] the objective has a DUV focus in a DUV wavelength region λ_{DUV} = 248 nm ± 8 nm and an IR focus at λ_{IR} = 760 nm [and possesses the data listed in Table 1].

11. (Amended) The objective as defined in Claim 7, wherein [it] the objective has a DUV focus in a DUV wavelength region λ_{DUV} = 248 nm ± 8 nm and an IR focus at λ_{IR} = 825 nm [and possesses the data listed in Table 2].

12. (Amended) The objective as defined in Claim 7, wherein [it] the objective has a DUV focus in a DUV wavelength region λ_{DUV} = 248 nm ± 8 nm and an IR focus at λ_{IR} = 885 nm [and possesses the data listed in Table 3].

13. (Amended) The objective as defined in Claim 7, wherein [it] the objective has a DUV focus in a DUV wavelength region λ_{DUV} = 248 nm ± 8 nm and an IR focus at λ_{IR} = 905 nm [and possesses the data listed in Table 4].

14. (Amended) The objective as defined in Claim 8, wherein [it] the objective has a DUV focus in a DUV wavelength region λ_{DUV} = 266 nm ± 8 nm and an IR focus at λ_{IR} = 780 nm [and possesses the data listed in Table 6].

15. (Amended) The objective as defined in Claim 7, wherein [it] the objective has a DUV focus in a DUV wavelength region λ_{DUV} = 266 nm ± 8 nm and an IR focus at λ_{IR} = 785 nm [and possesses the data listed in Table 7].

16. (Amended) The objective as defined in Claim 8, wherein [it] the objective has a DUV focus in a DUV wavelength region $\lambda_{DUV} = 266$ nm $\pm$ 8 nm and an IR focus at $\lambda_{IR} = 845$ nm [and possesses the data listed in Table 8].

17. (Amended) The objective as defined in Claim 1, wherein [the IR focus lies between 760 nm and 920 nm] λ_{IR} has a wavelength such that 760 nm $\geq \lambda_{IR} \geq$ 920 nm.

18. (Amended) The objective as defined in Claim 1, wherein [the DUV focus lies between 200 nm and 300 nm] the objective has a focal length of 1.6 mm or less.

Version with Markings to Show Changes Made (Abstract)

A DUV-capable dry objective for microscopes comprises lens groups made of quartz glass, fluorite, and in some cases also lithium fluoride. It possesses a DUV focus for a DUV wavelength region $\lambda_{DUV} \pm \Delta\lambda$, where $\Delta\lambda = 8$ nm, and additionally a parfocal IR focus for an IR wavelength λ_{IR}, where 760 nm [=] $\underline{\geq}$ λ_{IR} [=]$\underline{\geq}$ 920 nm. For that purpose, the penultimate element is of concave configuration on both sides, and its object-side outer radius is much smaller than its image-side outer radius. The DUV objective is IR autofocus-capable.